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and generate a net output of 205 MW. Later studies[7,8,11] indicated that higher efficiencies, 51.7% –53.5%, can be achieved with higher methane producing gasifiers and by using hot gas clean-up. More recently[12], studies of hybrid fuel cell/turbine systems have shown that LHV efficiencies of 70% can be achieved on natural gas. This system utilizes a gas turbine as a bottoming cycle to the fuel cell, as shown in Figure 5. This concept can be applied to coal gas systems as well.

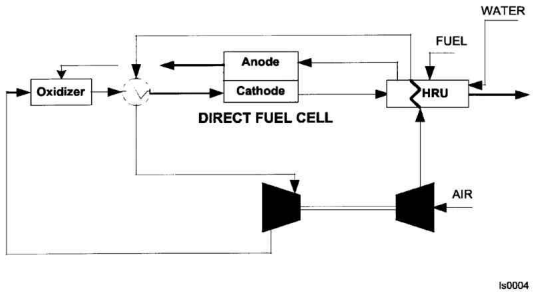

Figure 5
High Efficiency Hybrid Fuel Cell/Turbine Power Cycle

Emissions from this plant would be extremely low and below any current or anticipated future standards. Figure 6 compares the combined SOx, NOx, and solid waste emissions of existing commercial technologies, IGCC and IGFC. IGFC technology achieves the lowest levels of pollutant emissions in addition to lower CO_2 emissions and make-up water requirements. The CO_2 emission is 1.54 lb/kWh and the make-up water requirement is 6.8 GPM/MWh.

Figure 6
Environmental Impact Comparison of IGFC and Other Technologies

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Experimental testing

Experimental testing of a 20 kW sub-scale fuel cell stack was conducted[9] at Louisiana Gasification Technology Inc. (LGTI) in 1993-4 by Destec as shown in Figure 7. This was the world's first test of a carbonate fuel cell on coal derived gas. Gas from the entrained flow Destec gasifier was further cleaned-up after bulk gas clean-up by the fuel cell test facility and supplied to the fuel cell. The fuel cell operated on syn gas from the gasifier and inter-changeably with natural gas providing normal perform-ance and stable operation.

Figure 7
20 kW Carbonate Fuel Cell Test at the LGTI Gasification Facility

After completion of the test, the fuel cell was disassembled for post-test inspection. Analysis of the components indicated no evidence of degradation and no detectable accumulation of coal gas borne contaminants in the fuel cell electrolyte or in the hardware. These results paved the way for a larger scale demonstration test.

Clean coal demonstration test

FuelCell Energy is planning to build and test a 2-MW carbonate fuel cell power plant as part of the Kentucky Pioneer Energy Project by Global Energy. The plant will be located in Trapp, KY and will be operational in 2003. This project, supported by DOE as part of the Clean Coal Technology Program will include a 400-MW Integrated Gasification Combined Cycle (IGCC) and a 2-MW fuel cell power plant (Integrated Gasification Fuel Cell, IGCF) as shown in Figure 8. The project will feature Advanced Fuel Technology briquettes made of Kentucky coal and Municipal Solid Waste (MSW) as fuel in the gasification process, adding a renewable fuel component to the project. The use of municipal solid waste as fuel reduces fuel cost to the power plant and provides low cost waste elimination. British Gas/Lurgi (BGL) gasification technology and General Electric advanced turbine power generation will be utilized for the IGCC.

As shown in Table 1 emissions from this plant will be significantly lower than conventional coal fired plants using PC boiler, atmospheric fluidized bed, and pressurized fluidized bed technologies.

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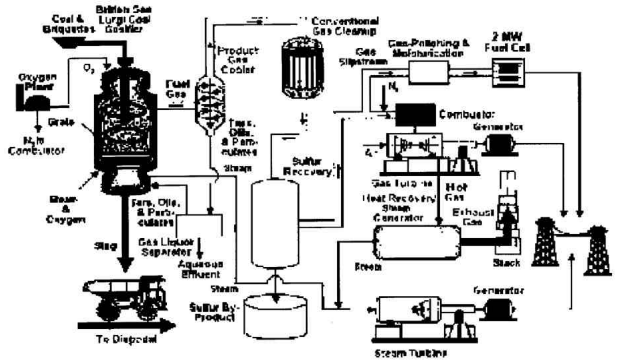

Figure 8
400-MW IGCC and 2-MW Fuel Cell Power Plant Process Flow Diagram[14]
Source: DOE Project Fact Sheet (Modified)

Table 1
Typical Emission Levels and Waste from Coal Based Power Plant Types

2.5% SULFUR EASTERN COAL *Source: EPRI With Adjustments By Duke Energy*				
PLANT TYPE	SO_2 EMISSIONS LB/MWH	NO_x EMISSIONS LB/MWH	SOLID WASTE (DRY) LB/MWH	CO_2 VENT GAS LB/MWH
Pulverized Coal (PC w/ESP Only)	35.7	11.2	136	1871
Pulverized Coal with FGD and LNB (90 percent S Removal, NO_x Control	3.6	5.8	232	1908
Atmospheric Fluidized Bed Combustion (AFBC)	3.6	4.9, 0.5 (SNCR)	249	1975
Pressurized Fluidized Bed Combustion (PFBC)	3.3	0.9	230	1826
Integrated Gasification combined cycle (IGCC) (99 Percent S Removal)	0.3	0.9	123	1695
BGL IGCC (99 Percent S Removal, 15 PPM NO_x)	**0.3**	**0.4**	**115**	**1585**
BGL IGFC	**0.25**	**0.18**	**90**	**1540**

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References:

1. U.S. DOE/EIA "Annual Energy Review 1998".

2. U.S. DOE/EIA "Annual Energy Outlook 2000".

3. Graves, H., Global Energy Inc., Personal Communication, December 1999.

4. Farooque, M, G. Steinfeld, G. McCleary, S. Kremenik, "Assessment of Coal Gasification/Carbonate Fuel Cell Power Plants", Topical Report to DOE/METC, June, 1990, DOE/MC/23274-2911. NTIS/DE90015579.

5. Sander M.T., et al, Fluor Daniel, G. Steinfeld, Fuel Cell Energy, "Cost and Performance Analysis for a 220 MW Phased Construction Carbonate Fuel Cell Power Plant", 11th Annual Conference on Gasification Power Plants, EPRI, October 1992.

6. Sandler H.S., and S.J. Meyers, "Integrated Coal Gasification in Carbonate Fuel Cell Power Plants" 11th Annual Conference on Gasification Power Plants, EPRI, October 1992.

7. EPRI, AFPS Developments, Gasification/Fuel Cell Study Projects Very Low Heat Rate, Winter 1990 Issue 6.

8. Meyers S., Fluor Daniel, Advanced Molten Carbonate Fuel Cell Systems Using BGL Gasification, Presented at the 9th Annual Conference on Gasification Power Plants, October 16-19, 1990, Palo Alto, CA.

9. Rastler, D.M., EPRI, C.G. Keeler, Dow Chemical USA, "Slip Stream Test of a 20 kW Carbonate Fuel Cell Unit at Destec's LGTI GCC Facility", Presented at the EPRI Gasification Conference, Oct 1993.

10. Kluttz D.E., Duke Engineering & Services Inc., et al, "Proposed BGL CGCC Project for Clean Coal Technology Round Five Demonstration", Presented at the EPRI Gasification Conference, Oct 1993.

11. Steinfeld,G., W. Willson "Advanced Power System Featuring a Closely Coupled Catalytic Gasification Carbonate Fuel Cell Plant" Presented at the 17th Biennial Low-Rank Fuels Symposium, May 10-13, 1993, St. Louis, Missouri.

12. Ghezel-Ayagh, H., R. Sanderson, A. J. Leo, "Ultra High Efficiency Hybrid Direct Fuel Cell/Turbine Power Plant", Proceedings of Carbonate Fuel Cell Technology V, PV 99-20, page 297-305, 190th Meeting of the Electrochemical Society, Oct. 7-22, 1999, Hawaii.

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13. DOE Fossil Energy TechLine, "Richardson Approves Federal Funding for High Tech, Ultra Clean Coal Plant in Kentucky", U.S. DOE Press Release issued November 15, 1999.

14. DOE Clean Coal Technology, Compendium, Project Fact Sheet, Advanced Electric Power Generation Integrated Gasification Combined Cycle, Clean Energy Demonstration Project.

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Appendix D

COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION
In the Matter of:
APPLICATION OF EAST KENTUCKY POWER COOPERATIVE, INC. FOR A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY, AND A CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY, FOR THE CONSTRUCTION OF A 250 MW COAL-FIRED GENERATING UNIT (WITH A CIRCULATING FLUID BED BOILER) AT THE HUGH L. SPURLOCK POWER STATION AND RELATED TRANSMISSION FACILITIES, LOCATED IN MASON COUNTY, KENTUCKY, TO BE CONSTRUCTED ONLY IN THE EVENT THAT THE KENTUCKY PIONEER ENERGY POWER PURCHASE AGREEMENT IS TERMINATED
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CASE NO.
2001-053
O R D E R
East Kentucky Power Cooperative, Inc. ("East Kentucky") filed its application on March 9, 2001 for a Certificate of Public Convenience and Necessity and a Certificate of Environmental Compatibility to construct a 250 MW coal-fired generating unit, referred to as "Gilbert," at the Hugh L. Spurlock power station ("Spurlock") and related transmission facilities in Mason County, Kentucky. The Gilbert unit was to be constructed only in the event that East Kentucky's prior agreement to purchase the output of a 540 MW generating unit proposed by the Kentucky Pioneer Energy, L.L.C. ("KPE") is terminated. The Attorney General's Office ("AG") and the Kentucky Natural Resources and Environmental Protection Cabinet, Department of Natural Resources, Division of Energy ("DOE") were granted intervention and a hearing was held on August 18, 2001..

On July 11, 2001, East Kentucky amended its application to eliminate the contingent nature of its request because KPE had not met its financial closing deadline of June 30, 2001. The amended application also revised Gilbert's output from 250 MW to 268 MW. East Kentucky has not terminated the power purchase agreement because the power will be sold at a very reasonable price and KPE has indicated that it believes it can obtain project financing by March 2002. However, due to the delay in KPE's financing, East Kentucky decided that it cannot reasonably rely on that project to satisfy its future power supply needs. Therefore, East Kentucky has concluded that it should proceed to build the Gilbert unit. In the event that KPE is able to secure project financing, East Kentucky stated that certain provisions in the existing purchase power agreement would have to be revised and any renegotiated contract will be resubmitted to the Commission for its prior approval.

East Kentucky submitted to the Natural Resources and Environmental Protection

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